Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	**)**
	)
Carrier Current Systems, Including Broadband	**)**
over Power Line Systems	**)**
	)ET Docket 04-37
Amendment of Part 15 regarding new	**)**
requirements and measurement guidelines for	**)**
Access Broadband over Power Line Systems	**)**

Comments of Scott D. Prather and Anne H. Prather

Introduction

In response to the Federal Communication Commission's Notice of Proposed Rulemaking regarding Access Broadband over Power Line Systems (ET Docket #04-37), Scott D. Prather, licensee of amateur radio station N7NB and Anne H. Prather, licensee of amateur radio station KA9EHV, wish to provide the following comments for consideration by the Commission.

During the NOI portion of this proceeding, we were continually frustrated by the BPL proponents' claims that there would be little, if any, interference to existing spectrum users resulting from the deployment of BPL, and that existing Part 15 regulations were sufficient to protect incumbent users. BPL proponents continued to claim that, in essence, they had changed the laws of physics to accommodate BPL. Subsequently, we were pleased to see that the report recently published by NTIA entitled *"Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz"* Phase 1 Study report, NTIA Report 04-413, U.S. Department of Commerce, National Telecommunications and Information Administration, confirmed our position that achieving BPL spectrum compatibility with existing spectrum users is far from being a trivial matter.

Our comments frequently reference NTIA report 04-413, and we urge the Commission to look closely at this body of work. NTIA has performed a large number of tests in actual BPL test markets, and their conclusions are based on sound engineering principles. Wherever possible, the Commission should employ the many recommendations made by NTIA in order to minimize the spectral pollution that may otherwise result from the deployment of BPL based on existing FCC Part 15 rules and regulations.

NPRM Concerns

Adaptive Interference Mitigation

We are especially concerned about the Commission's concept of “adaptive interference mitigation”, specifically because this term is not defined. For example, does “adaptive” mean that the system must adapt in real-time or is manual intervention from the BPL operator required? Below, we cite two potential scenarios for adaptive mitigation and the regulatory questions they pose:

Scenario #1, Automatic Interference Mitigation: For this method, we assume that automatic interference mitigation requires the BPL system to recognize the presence of RF in a certain frequency range, and disable BPL emissions in and around the frequency where RF was detected. This scenario raises questions such as:

a. What ambient RF level would be required to trigger adaptation?

b. Once an RF signal has been detected, how much spectrum will be cleared on either side of the frequency where RF was detected?

c. How long will the BPL adaptive interference mitigation remain in place after the ambient RF that triggered it is no longer present?

d. If adaptive mitigation fails to respond or is ineffective, what recourse will be available to the licensed service and what penalties will be imposed on the BPL operator for continued interference?

e. In the case of interference to broadcast bands, how will interference mitigation be invoked when the listener has no way to legally transmit a signal in order to trigger adaptation by the BPL system?

Scenario #2, BPL Operator Involvement: If “adaptive interference mitigation” is defined as manual intervention on the part of the BPL operator, this scenario raises the following questions:

a. How will an affected party contact the BPL operator to eliminate the interference on a 24-hour basis?

b. How quickly must interference mitigation be invoked by the BPL operator once an interference report is received, and what recourse is available to the affected party in the event the report is not acted on promptly?

c. How much spectrum will be cleared on either side of the frequency reported by the licensed station? In the case of interference to amateur stations that are typically frequency agile, will the BPL operator be required to invoke interference mitigation across the entire affected band?

d. If interference is received on multiple bands, how quickly will BPL operators be required to invoke mitigation on all the affected bands?

e. If the BPL operator invokes mitigation techniques but they are ineffective, how will such interference cases be resolved and what penalties will be imposed for continued interference?

Especially in the case of Scenario 2 above, it may be difficult for a BPL operator to maintain sufficient staff to handle interference mitigation requests. Historically, electric utilities have a rather poor track record when it comes to handling interference complaints related to loose connections, bad insulators, etc., all of which are central to the utilities's primary function of providing electrical service to customers. BPL adds a layer of complexity to the interference resolution process that the utilities have never had to contend with before, and interference mitigation for heavily used portions of the HF spectrum could easily become a huge burden. In one of the small and carefully-controlled test systems currently operating in North Carolina, the utility providing BPL service had not enabled interference mitigation to two amateur bands, even after the reporting party had waited in excess of 60 days[1] and made numerous follow-up calls. This does not bode well for anything resembling prompt interference mitigation as part of a wide-scale BPL deployment. Such non-compliance with Part 15 should expose the BPL operator to substantial monetary fines and/or require the operator to shut down the portion of the network causing such interference.

Because of the logistical problems mentioned earlier, we feel quite strongly that it is in the best interest of all parties involved to require mandatory protection to certain frequency bands in the 1.7-80 MHz spectrum. The implementation of protected frequency bands is not without precedent in BPL. As a proactive effort, developers of the HomePlug 1.0 standard included notches for all of the amateur radio bands within its 4.5-21 MHz operating range. The concept of mandatory protected frequency bands was also recommended by NTIA[2] a means by which vital federal communications frequencies could be protected from interference. In Table 4.9 of the NTIA report, they propose a list of federal government frequencies to be protected from interference. NTIA's recommended list of protected frequencies constitutes 6% of the spectrum between 1.7-30 MHz, and 5.5% of the spectrum from 30-80 MHz.

We fully support NTIA's table of recommended frequencies requiring mandatory protection, and we also propose the inclusion of the frequencies listed in Table 1 below:

Table 1: Proposed Frequency Ranges Subject to Mandatory Protection from BPL

Service	Licensed Frequency Range
Amateur	1.8-2.0 MHz
Amateur and Broadcast	3.5 - 4.0 MHz
Amateur	5.2-5.3 MHz
Amateur and Broadcast	7.0-7.3 MHz

1. "BPL Primer: How Do I Know What I'm Hearing?" Gary Pearce, KN4AQ, CQ Magazine May, 2004, Page 3, available at http://www.cq-vhf.com/BPL.html.
2. NTIA Report 04-413 "Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz" Phase 1 Study report U.S. Department of Commerce, National Telecommunications and Information Administration, Section 4.6, Page 4-8.

Table 1: Proposed Frequency Ranges Subject to Mandatory Protection from BPL

Service	Licensed Frequency Range
Amateur	10.1-10.15 MHz
Amateur	14.0-14.35 MHz
Amateur	18.069-18.169 MHz
Amateur	21.0-21.450 MHz
Amateur	24.890-24.990 MHz
Amateur	28.0-29.7 MHz
Amateur	50.0-54.0 MHz

Note: The frequency bands in Table 1 may require a guardband on either side of the licensed allocation to eliminate interference to the protected service. In the case of a pulsed BPL emission such as OFDM, the guardband may be required to minimize the effects of sideband interference that extends beyond the last active OFDM subcarriers one either side of the notch. In the case of DDS systems, the guardband would correspond to that required to realize a sufficient notch to minimize the emission's effect on a narrow-band receiver. The width of the guardband is not proposed in this document because of the variables involved, and is left to the BPL equipment provider to implement and specify.

The protected frequency bands in Table 1 amount to 14% of the spectrum below 30 MHz, and 8% of the spectrum between 30 and 80 MHz. This is a relatively small price to pay in terms of bandwidth considering the expense of acting on the numerous interference complaints that will inevitably arise in congested urban and suburban areas where spacing between the power lines and amateur antennas is limited.

In order for a frequency band to be considered "protected", we propose that BPL signals within the frequency bands listed in Table 1 be attenuated to at least -40 dBc, where 0 dBc is defined as the power required to meet the FCC 15.209 radiated limit after taking any frequency effects of the power lines into account. This -40 dBc requirement includes fundamental, harmonic and intermodulation emissions. In cases where the ambient noise level (from emissions other than BPL) in a given frequency range is higher than the -40 dBc level, the higher of the two will prevail. We also propose that this -40 dBc emission limit be applied to all frequencies outside the specific frequency range of each BPL device to minimize the potential for interference to other services.

It is not sufficient to depend entirely upon certification of the BPL devices themselves, as compliance with our proposed -40 dBc attenuation level is determined by the design of the BPL devices and the characteristics of the power line to which they are connected. In other words, compliance with our proposed -40 dBc emissions level must be verified as a system parameter.

Compliance Verification

Measurement Antenna

As the previous section of our comments indicate, compliance with Part 15 must be verified with the devices operating as a system. There must also be a means of verifying compliance in a standardized manner. The current FCC 15.31 regulations call for verification of emissions below 30 MHz using a loop antenna, which responds to the emission's H-field component. However, compliance with FCC 15.209 is based on an E-field specification. Across the 1.7-30 MHz range, accurate conversion from an H-field to E-field measurement is not easily realized. We concur with NTIA that all BPL compliance measurements should be made using a calibrated rod antenna[3].

In addition to changing the measurement antenna type to an E-field rod antenna, we recommend that the height of the measurement antenna be increased as well. The current methodology of making measurements at a typical height of 1 meter is insufficient, as it will frequently underestimate the field strength of the BPL emission. Because most amateur antennas are at a height equal to or greater than surrounding power lines, compliance measurements should be made at a height equal to that of the power lines themselves. NTIA reports that measurements made at low heights (e.g. 1-4 meters) when the measurement antenna is close to the power line (i.e. 10 meters or less) may result in substantial measurement errors, where the actual field strength is typically underestimated by 3 to 15 dB[4]. Therefore, we recommend that compliance measurements be made at a minimum antenna height of 10 meters, and any measurements made at a lower height must have an appropriate correction factor introduced.

Frequency Effects

BPL radiation from the power lines is highly dependent on variables that are not easily quantified. For example, mismatches and the resulting reflections caused by power line length, the location of discontinuities, etc., will vary considerably by frequency and the specific attributes of each installation. Consequently, it is not sufficient for the BPL operator to validate compliance at only one frequency or frequency band, compliance must be measured in every frequency range that the BPL devices are capable of operating, as recommended by NTIA[5]. If the BPL operator intends to fix the frequency of each device so that it cannot be changed in a given installation, it may be permissible to validate compliance on that frequency range only. However, we suspect that most BPL devices will be

3. NTIA Report 04-413 "Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz" Phase 1 Study report U.S. Department of Commerce, National Telecommunications and Information Administration, section 7.8, page 7-5.
4. NTIA Report 04-413 "Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz" Phase 1 Study report U.S. Department of Commerce, National Telecommunications and Information Administration, section 7.4, page 7-3.
5. NTIA Report 04-413 "Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz" Phase 1 Study report U.S. Department of Commerce, National Telecommunications and Information Administration, section 7.7, page 7-

frequency-agile to accommodate interference management to and from other devices in the network.

Output Power

To minimize the potential for interference, BPL systems must comply with FCC 15.15, which requires that the device use the minimum output power for the desired communication. Because of the frequency effects mentioned in the previous section, it is possible that a BPL device and its associated transmission line will be compliant on one frequency band but non-compliant on another unless the output power is lowered. Since the potential exists for any given BPL device to be moved to different frequency ranges (depending upon local considerations), we recommend that the maximum output power required for compliance on each frequency range the device is capable of supporting be programmed into the device when it is commissioned and/or replaced. This will allow the BPL operator to move the frequency of devices without concern for compliance with FCC 15.209.

Device Database

We strongly support the Commission's desire to require that the location of all deployed BPL devices to be included in a database, preferably accessible to the public. In order to maintain security and alleviate customer privacy concerns, we feel that it would be acceptable to limit the location information in this database to devices on the utility's side of the drop, not the equipment located in customer's homes. This proposal has the advantage of supporting the same level of information regardless of whether the BPL provider interconnects to the end user via the LV power drop or via 802.11.

Our proposal assumes that both the uplink and downlink frequency bands will be included in this database, and that the database will be kept current (e.g. all network changes updated in the database within 2 weeks).

In order for this database to be of use to entities attempting to track down the source of BPL interference, it will be necessary to require each BPL device on the utility's side of the drop to transmit a unique identification. This identification must be made by a means which will allow it to be decodeable without special equipment. We recommend a repeating Morse ID, preferably transmitted at each extreme of the BPL frequency band in use by the device.

Other Matters of Concern

Ability to Opt-Out

In BPL systems where the signal is made available to the end user via LV lines to the home, it should be possible for customers to "opt-out" of the presence of these signals on their home wiring. The presence of these unnecessary signals increases the likelihood of incurring harmful interference that must be mitigated by the BPL provider. Instead, we recommend that filters be available to block the transmission of BPL signals to homes and

businesses that request the ability to opt-out. The filter or blocking device should be designed such that it will not generate reflections on the power line. This concept of including devices to block BPL to locations where it is not needed was suggested by NTIA[6] as a means to minimize BPL interference from power lines beyond the designed "service area" of a BPL device.

Customer Understanding of BPL's Compliance with FCC Part 15

Although the Commission has required all Part 15 devices sold in the US to include a statement indicating that the device must not cause interference and must accept any interference it receives, very few consumers understand what this statement means, if they read it at all. In the case of devices such as baby monitors, cordless phones, etc., the interference potential is relatively low and a consumer's lack of understanding for Part 15 has not proven to be much of an issue. However, Internet access via BPL is an entirely different matter. The interference potential of BPL is much higher than with highly localized devices such as cordless phones. Unlike a consumer who may have to stop using his cordless phone to prevent interference (and the consumer is aware that the interference is caused by his particular device), the need to lower output power and/or shut down portions of the BPL system takes interference control out of the hands of the customer and may degrade or interrupt their Internet connectivity. Customers need to be made acutely aware of this when they sign up for Internet service via BPL. Instead of relying on a Part 15 compliance label or other document that the customer will probably never read let alone understand, BPL operators signing up customers should be required to deliver an easily-understandable document to the customer indicating that their service may be impacted by interference, and that interruptions to their service may be necessary to eliminate interference. This disclosure must be signed and dated by the customer before BPL service to the customer may commence. If the customer moves and the BPL service is transferred to the new owner, a new disclosure form must be executed by the BPL provider.

Summary

We are both in technical fields (biology and wireless telecommunications) and we applaud the government's pro-technology position. However, we recognize that to be viable, a technology must be robust, cost-effective, and appealing to the end user. As our comments indicate, BPL fails on two of these three criteria. Moreover, there are many existing technologies which pass on all three. We should not begin deployment of BPL without a thorough examination of the consequences of this technology.

Respectfully Submitted,

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6. NTIA Report 04-413 "Potential Interference from Broadband Over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz" Phase 1 Study report U.S. Department of Commerce, National Telecommunications and Information Administration, section 8.5, page 8-3